

REMARKS

This amendment responds to an Office Action dated January 25, 2005. Prior to this response claims 8-10 and 12-25 were pending. After amending claims 8, 14, 16, and 20-22, claims 8-10 and 12-25 remain pending.

Section 2 of the Office Action has rejected claims 8-10, 12-14, 16-18 and 20-25 under 35 U.S.C. 102(e) as being anticipated by Lopatin et al. ("Lopatin"; U.S. Pat. No. 6,368,954). The Office Action states that Lopatin teaches a second nitride barrier layer overlying a first metal nitride. In the *Response to Arguments* Section, the Office Action states that Lopatin describes first and second nitrides, of different thicknesses, that can be formed directly overlying each other.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

To further clarify the distinctions of the claimed invention, claims 8, 14, and 21 have been amended to recite that the first metal of the first metal nitride is a different material than the second metal of the second metal nitride. That is, the claim recites that the first and second metals are different materials.

Barrier layer 401 of Lopatin may be formed "by a multiplicity of process cycles." (Col. 4, lines 46-47). However, each process cycle deposits the same nitride to build up the thickness of barrier layer 401 comprised of a single barrier layer material. Therefore, even if Lopatin does describe

overlying metal nitride layer than can be differentiated by thickness, the overlying layers are not formed from different metal materials.

Lopatin does not describe a second metal nitride layer overlying a first metal nitride layer, where the first and second metals are different materials. Therefore, Lopatin does not explicitly describe every element of claims 8, 14, and 21. Since Lopatin does not describe every limitation, he cannot anticipate claims 8, 14, and 21. Claims 9-10 and 12-13, dependent from claim 8, claims 16-18 and 20, dependent from claim 14, and claims 22-25, dependent from claim 21, enjoy the same distinctions from the cited prior art and the Applicant requests that the rejection be removed.

In Section 3 of the Office Action, claims 8-10, 12-18 and 20-25 have been rejected under 35 U.S.C. 102(e) as being anticipated by Satta et al. ("Satta"; U.S. Pat. No. 6,391,785). The Office Action states that Satta teaches a second nitride barrier layer overlying a first metal nitride. In the *Response to Arguments* Section, the Office Action states that Satta describes first and second nitrides, of different thicknesses, that can be formed directly overlying each other.

As in Lopatin, Satta teaches that layer 26 can be built up in sequential steps, where each step involves the formation of one atomic layer by a chemical reactor or adsorption (Col. 11, ln. 27-43). Satta does not teach or suggest different layers of a barrier metal thin film being comprised of overlying first and second metal nitride layers, where the first metal is a different material than the second metal. Therefore, Satta does not explicitly describe every element of claims 8, 14, and 21. Since Satta does not describe every limitation, he cannot anticipate claims 8, 14, and 21. Claims 9-10 and 12-13, dependent from claim 8, claims 16-18 and 20, dependent from claim 14, and claims 22-25, dependent from claim 21, enjoy the same distinctions

from the cited prior art and the Applicant requests that the rejection be removed.

Section 4 of the Office Action has rejected claims 21-25 under 35 U.S.C. 102(e) as anticipated by Leem (U.S. Pat. No. 6,284,646). The Office Action states that Leem teaches a second nitride barrier layer overlying a first metal nitride. In the *Response to Arguments* Section, the Office Action states that Leem describes directly overlying first and second nitride layers.

Leem, at Col. 6, ln. 9-65, describes a stack of materials that includes a buffer layer 26 overlying a conductive layer 24, which overlies a diffusion buffer layer 22. Both buffer layers 26 and 22 can be formed from a group of materials including some refractory metal nitrides.

To further clarify the distinctions of the claimed invention, claim 21 has been amended to recite that the second metal nitride layer overlies the first metal nitride layer, without an intervening material layer. Leem shows and describes a conductive layer 24 (i.e., Al) intervening between diffusion layers 26 and 22. Therefore, Leem does not describe a second metal nitride layer overlying a first metal nitride layer, without an intervening material layer. As a result, Leem does not explicitly describe every element of claim 21. Since Leem does not describe every limitation, he cannot anticipate claim 21. Claims 22-25, dependent from claim 21, enjoy the same distinctions from the cited prior art and the Applicant requests that the rejection be removed.

In Section 5 of the Office Action, claims 15 and 19 have been rejected as unpatentable under 35 U.S.C. 103(a) with respect to Lopatin. The Office Action acknowledges that Lopatin does not describe the recited time periods and thicknesses. The Office Actions states, however, that it would

have been obvious to derive the time and thicknesses limitations. This rejection is traversed as follows.

An invention is unpatentable if the differences between it and the prior art would have been obvious at the time of the invention. As stated in MPEP § 2143, there are three requirements to establish a *prima facie* case of obviousness.

First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. *In re Vaeck* 947 F.2d 488, 20 USPQ2d, 1438 (Fed. Cir. 1991).

With respect to the first *prima facie* requirement, there must be some suggestion in the reference or in the generally available knowledge to modify Lopatin in such a way as to make the claimed invention obvious. The first and second metal nitride barrier layers recited in Applicant's claim 14 were developed to improve adhesion and step coverage, especially on Cu films (specification page 4, ln. 19 through page 5, ln 13). Lopatin's process is a reaction to a problem that occurs in the formation of Cu interconnects (Col. 2, ln. 53 through Col. 3, ln. 2). Lopatin's solution is to fabricate an interconnect structure including a diffusion barrier, a pre-seed layer over the diffusion barrier, and a seed layer over the pre-seed layer (Col. 3, ln. 22-38). In short, Lopatin does not recognize the advantages of forming overlying first and second metal nitride layers, from different metal materials. Since Lopatin does not recognize the advantages of such a structure, there is no

suggestion that Lopatin be modified is such a way as to make the claimed invention structure obvious.

The second *prima facie* requirement considers obviousness from a different point of view. If an expert were given the Lopatin patent as a foundation, could the expert reasonably be expected to derive the claimed invention without undue experimentation? However, there is nothing in the Lopatin disclosure to suggest the advantages of using overlying first and second metal nitride layers of different metal materials.

With respect to the third *prima facie* requirement, Lopatin does not explicitly describe overlying first and second metal nitride layers of different metal materials. Therefore, Lopatin does not explicitly describe all the limitations of claim 14. Neither does Lopatin suggest any modification that would make the limitations of claim 14 obvious. Claims 15 and 19, dependent from claim 14, enjoy all the above-mentioned distinctions from the cited prior art and the Applicant requests that the rejections be removed.

In Section 6 of the Office Action, claim 19 has been rejected as unpatentable under 35 U.S.C. 103(a) with respect to Satta. The Office Action acknowledges that Satta does not describe the recited time periods and thicknesses. The Office Actions states, however, that it would have been obvious to derive the time and thicknesses limitations. This rejection is traversed as follows.

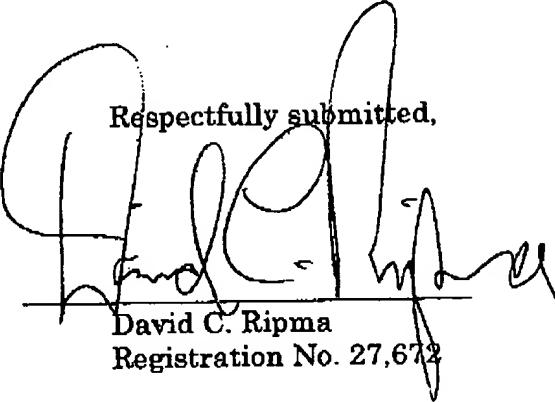
With respect to the first *prima facie* requirement, there must be some suggestion in the reference or in the generally available knowledge to modify Satta in such a way as to make the claimed invention obvious. Satta's invention is a reaction to a problem associated with Cu migration diffusion barriers (Col. 1, ln. 42 through Col. 2, ln 17). Satta's solution forms barriers overlying insulating sidewalls, but not over conductive sidewalls

(Col. 2, ln. 37-57). Satta does not appear to recognize the advantages of forming overlying first and second metal nitride layers, from different metal materials. This is especially true since Satta is solving a different problem than the claimed invention. Since Satta does not recognize the advantages of forming a barrier of overlying metal nitrides layer of different metal materials, there is no suggestion that Satta be modified in such a way as to make such a structure obvious. With respect to the second *prima facie* requirement, there is no reasonable expectation that an expert, given the Satta patent as a foundation, could reasonably be expected to derive the claimed invention without undue experimentation.

With respect to the third *prima facie* requirement, Satta does not explicitly describe overlying first and second metal nitride layers of different metal materials. Therefore, Satta does not explicitly describe all the limitations of claim 14. Neither does Satta suggest any modification that would make all the limitations of claim 14 obvious. Claim 19, dependent from claim 14, enjoys all the above-mentioned distinctions from the cited prior art and the Applicant requests that the rejections be removed.

It is believed that the application is in condition for allowance
and reconsideration is earnestly solicited.

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Respectfully submitted,

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